

What is claimed is:

1. A layered sheet construction comprising:

- a. at least one gas permeable, water impermeable layer; and
- b. a gas delivery layer proximate said at least one gas permeable layer,

5 wherein said layered sheet construction is used for the substantial removal of one or both of at least one organic substance and at least one nitrogen source from an aqueous medium containing one or both of at least one organic substance and at least one nitrogen source.

10 2. The layered sheet construction of claim 1, wherein said at least one gas permeable layer is microporous.

15 3. The layered sheet construction of claim 2, wherein said at least one microporous, gas permeable layer has pore sizes that are about 0.5 micrometers or less.

4. The layered sheet construction of claim 2, wherein said microporous, gas permeable layer is coated with a gas permeable, polymeric coating.

5. The layered sheet construction of claim 1, wherein said gas permeable layer is either one or both of undulated and corrugated in shape.

20 6. The layered sheet construction of claim 1, wherein said gas delivery layer comprises a base having two major sides, at least one side having a textured surface, and wherein said at least one gas permeable layer is proximate each said textured surface.

7. The layered sheet construction of claim 6, wherein said textured surface of said gas delivery layer comprises a plurality of walls.

25 8. The layered sheet construction of claim 7, wherein said plurality of walls form flow channels.

9. The layered sheet construction of claim 8, wherein said gas delivery layer further comprises microchannels in said base of said gas delivery layer that extend the length of said flow channels.

10. The layered sheet construction of claim 1, wherein said gas delivery layer comprises a dual gas delivery layer.

11. The layered sheet construction of claim 1, wherein said gas delivery layer further comprises a means for removing moisture from said gas delivery layer.

5 12. The layered sheet construction of claim 1, wherein said gas delivery layer comprises a material that is porous and gas permeable.

13. The layered sheet construction of claim 1, wherein said gas delivery layer comprises a foam.

14. The layered sheet construction of claim 1, wherein said gas delivery layer comprises a material that is selected from the group consisting of wovens and non-wovens.

10 15. The layered sheet construction of claim 1, wherein the layered sheet construction is either one or both of undulated and corrugated in shape.

16. The layered sheet construction of claim 1, further comprising a microbial population proximate said at least one gas permeable layer opposite the gas delivery layer.

17. The layered sheet construction of claim 1 wherein said at least one gas permeable layer is oleophobic.

18. The layered sheet construction of claim 1, further comprising at least one microbial support layer, wherein said at least one support layer is proximate said at least one gas permeable layer opposite the gas delivery layer.

20 19. The layered sheet construction of claim 18, wherein said microbial support layer is hydrophilic.

25 20. The layered sheet construction of claim 18, further comprising a microbial population, wherein said microbial population is either one or both of proximate said microbial support layer opposite the gas permeable layer and inside said support layer.

21. The layered sheet construction of claim 18 wherein said microbial support layer comprises a positively charged material.

5 22. The layered sheet construction of claim 18 wherein said microbial support layer comprises at least one absorptive filler material selected from the group consisting of finely-divided fossil lignocelluloses, peat, lignite, mineral coal, coke, charcoal, activated carbon, finely-divided distillation residues, granular metal oxides, inorganic fillers, plastic particles, and mixtures thereof.

10 23. The layered construction of claim 1, further comprising a means for supplying at least one gas to said gas delivery layer.

15 24. The layered sheet construction of claim 1, wherein said layered sheet construction is wound around into a spiral helix having successive winds spaced apart to form a gap.

20 25. An apparatus comprising a plurality of layered sheet constructions comprising:

- a. at least one gas permeable, water impermeable layer; and
- b. a gas delivery layer proximate said at least one gas permeable layer,

25 wherein said layered sheet constructions are used for the substantial removal of one or both of at least one organic substance and at least one nitrogen source from an aqueous medium containing one or both of at least one organic substance and at least one nitrogen source.

20 26. A process for the substantial removal of one or both of at least one organic substance and at least one nitrogen source from an aqueous medium containing one or both of at least one organic substance and at least one nitrogen source, comprising:

- a. providing at least one layered sheet construction, said layered sheet construction comprising:
 - i. at least one gas permeable, water impermeable layer; and
 - ii. a gas delivery layer proximate said at least one gas permeable layer;
- b. establishing a microorganism layer on said at least one gas permeable layer of said at least one layered construction;
- c. supplying at least one gas to said at least one gas delivery layer of said at least one layered construction; and

d. contacting said aqueous medium with said microorganism layer.

27. The process of claim 26, wherein said at least one layered sheet construction further comprises a microbial support layer proximate said at least one gas permeable layer and opposite said gas delivery layer, and wherein said microorganism layer is established one or both of on and in said microbial support layer rather than on said gas permeable layer.

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28. The process of claim 26, wherein said microbial support layer is hydrophilic.

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